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| **Title** | **MINING, TRANSPORTATION AND USE OF COAL BY POWER PLANTS** |
| **Level** | Middle/High School |
| **Subject** | Earth Science / Environmental Science |
| **Duration** | Two 30-45 minute lessons. |
| **Objectives** | 1. Name and describe each of the four types of coal.<br>2. Name two types of coal mining.<br>3. List the ways coal is transported.<br>4. Describe how power plants convert coal into electricity.<br>5. Calculate the cost of lighting your classroom. |
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**(1) How Is Coal Mined?**

Coal was initially obtained from the surface or near the surface where it was easily mined. Today where coal is found somewhat near the surface and the overlying layers of materials can be removed at a reasonable cost, it is mined using surface mining techniques. Where coal lies in deeper layers of the earth, it is reached through underground mining. There are different kinds of underground mines, such as drift, slope, and shaft.

The type of mine depends on where the coal is located. All types of mines use one of three methods of digging out the coal. These methods include room-and-pillar, long wall, and board and pillar techniques. The room-and-pillar method is used frequently in mines in the United States. Using this technique, the coal is mined or carved out and pillars (like huge columns) of coal are left to support the walls and ceilings of the passageways. Room-and-pillar does leave a substantial portion of the coal unmined. However, where possible some of the pillars are mined also.

**(2) What are the Types of Coal?**

In each underground mine, large holes (shafts) are also cut from the surface to the underground mining area for air and transportation for workers and for hauling coal out of the mine. Coal can be carried out of the mine on a conveyer belt or in small railcars on a track. There are four types (or "ranks") of coal mined today: **Anthracite, Bituminous, Subbituminous,** and **Lignite.**

Anthracite is the hardest and gives off much heat when burned but little smoke. Unfortunately there is little anthracite in the world. The other ranks of coal are softer, give out less heat, and increasingly more smoke. Bituminous coal is the next rank, followed by Subbituminous coal. Lignite, the youngest coal, is at the lowest end of the coal family and emits the most smoke. In some pieces of lignite you can even see the texture of the original plants (fossils) that formed the coal.

**(3) How Does Coal Get to the User?**

Many coal mines are far from the user. Therefore it is necessary to have an extensive transportation and storage system to get the coal to the consumer. Coal is transported by truck, train, barge, or freighter. Trucks are used for local transportation and are the most expensive form of hauling. Trains are also used for short or long hauling and are considerably cheaper than trucking. The least expensive method of hauling is by water routes using barges on rivers and lakes and freighters on ocean routes.

**(4) How is Coal Used to Make Electricity?**

A power plant can burn coal in a giant closed tub called a "boiler" that contains water. As the coal is burned, the water gets hot and turns into steam. *(This is like boiling water in a covered pot on your stove.)* The steam is collected from the top of the boiler and sent trough pipes to a "turbine" that contains a shaft on which blades are mounted. The steam rushing in causes the blades to turn like when you blow on the blades of a pinwheel. The turning blades cause the shaft that holds them to also turn or rotate. This shaft runs from the turbine into a "generator" unit. In this last box, a coil of wire is mounted on the shaft. Surrounding the coil of wire and the shaft is a magnet. When the shaft causes the wire coil to rotate, an

electrical current is created as the magnetic field is crossed by the wire coil. The electrical current is then collected by the wire coil and is sent on wires to your home and school as electricity.

**(5) Lights In Your School: How Much do They Cost to Run?**

Start by figuring how much electrical energy it takes to light your classroom for one hour. Expand your findings to the cost for 1 day, 1 week, etc.

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| Number of tubes in classroom | _____ | X | $.03 | = $ _____ cost per hour. |
| Cost per HOUR | $ _____ | X | _____ hours per day | = $ _____ cost per day. |
| Cost per DAY | $ _____ | X | _____ days per week | = $ _____ cost per week. |
| Cost per WEEK | $ _____ | X | _____ days per month | = $ _____ cost per month. |
| Cost per MONTH | $ _____ | X | _____ months per year | = $ _____ cost per year. |

Do you know how many fluorescent tubes there are in your school? Can you apply what you have learned about finding the costs for your classroom to finding the cost for the entire school?

How many kilowatt hours are used per year?

(number of watts per tube) x (number of tubes in the school) x (number of hours per year) = kwh per year.

_____ X _____ X _____ = kwh per year

An average of 2500 kwh of electricity are produced by burning 1 ton of coal.

1. How many tons of coal would it take to light your classroom for 1 year? _____
2. How many tons of coal would it take to light your school for 1 year? _____